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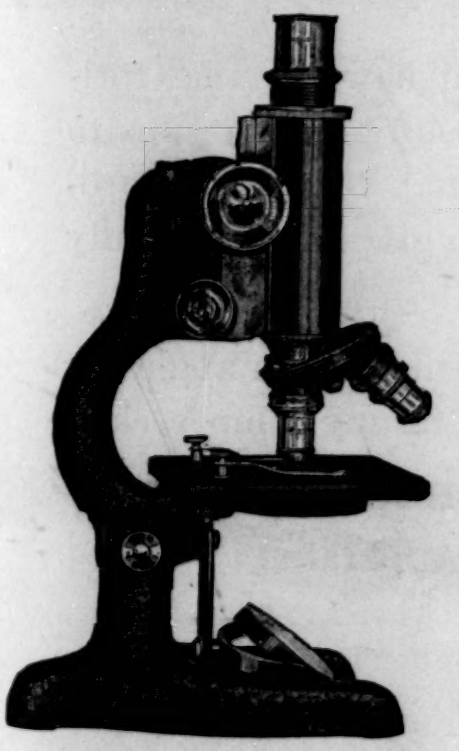

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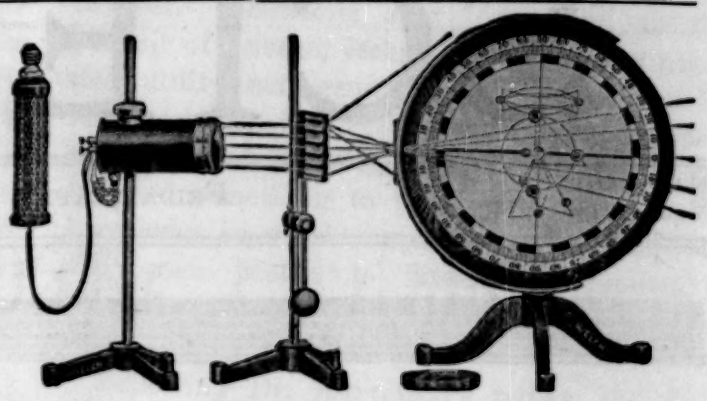

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE SECRETARY OF THE COMMITTEE ON GRANTS FOR RESEARCH

To the Executive Committee of the Council, American Association for the Advancement of Science.

Gentlemen:

In accordance with your request I submit the following report of the Committee on Grants for Research, this being a summary of the activities of the committee during the five years since its organization.

By the settlement of the Colburn estate in 1916 the association received cash and securities valued at about $76,000, bequeathed by Richard T. Colburn, a fellow of the association, the income of which is to be devoted "to original research in the physical and psychic demonstrable sciences." The association had accumulated a fund of about $25,000, mainly from the fees of fellows, life members, and members. The income from these funds being available for grants for research, the sum of $4,000 was, at the New York meeting of the association, on the recommendation of the treasurer, set aside for this purpose by the council, to be expended during the year 1917.

At the same time a Committee on Grants for Research was appointed, consisting of seven members under the chairmanship of Edward C. Pickering. These members, as well as their successors, were chosen so as to represent as far as possible the different sections of the association. At the meeting of the association in December, 1918, the committee was enlarged to include nine members, while a year later, with the adoption of the new constitution of the association, the number was changed to eight, the term of each member to be four years, with the arrangement of rotation so that two members should be succeeded by new appointees

each year. In 1920 the executive committee of the council voted that the Committee on Grants should thereafter elect its chairman and secretary.

Following is a list of persons who have served as members of the Committee on Grants, with the inclusive years of their respective terms:

Edward C. Pickering	1917-1918
E. C. Franklin	1917-1919
N. L. Britton	1917-1919
J. McKeen Cattell	1917-1919
W. B. Cannon	1917-1920
R. T. Chamberlin	1917-1920
Henry Crew	1917-1921
Louis I. Dublin	1919-1919
G. N. Lewis	1919-1921
G. H. Parker	1919-1921
Joel Stebbins	1919-1921
George T. Moore	1920-1923
Robert M. Yerkes	1920-1923
Arthur B. Lamb	1921-1922
C. Judson Herrick	1921-1924
David White	1921-1924

The chairmen of the Committee on Grants have been Edward C. Pickering (1917-1918), Henry Crew (1919-1920), and Robert M. Yerkes (1921-); and the secretaries, J. McKeen Cattell (1917-1918), and Joel Stebbins (1919-1921).

The committee has held its meetings annually, at first in Washington during the month of April, but recently in December in connection with the meetings of the association. Although the members are widely separated geographically, it has been possible to get enough of them together once a year to have an intelligent discussion of the business of the committee. Experience has shown that while a good deal of preparation can be carried on by correspondence, the final decisions and the apportionment of money for grants can be made satisfactorily only with the personal exchange of views at a meeting.

From the beginning it has been the policy of the committee to apportion the annually available amount as a number of small grants to individuals; in fact, with a total of about four thousand dollars each year, to cover all the sciences, there was no other choice than to apportion a number of small sums. Although other methods of procedure have been suggested, the council of the association has formally approved the policy of the committee in assigning miscellaneous grants to individuals, without undertaking to support specific lines of investigation which might stand as projects of the committee alone.

At the time of its organization the committee adopted a number of rules for its own guidance and for the information of those to whom grants are made. These rules, adopted in April, 1917, are as follows:

1. Application for grants may be made to the member of the committee representing the science in which the work falls, or to the chairman or secretary of the committee. The committee will not depend upon applications, but will make inquiry as to the way in which research funds can be best expended to promote the advance of science. In such inquiry, the committee hopes to have the cooperation of scientific men and especially of the sectional committees of the association.

2. The committee will meet at the time of the annual meeting of the association or on the call of the chairman. Business may be transacted and grants may be made by correspondence. In such cases the rules of procedure formulated by the late Professor Pickering and printed in the issue of SCIENCE for May 23, 1913, will be followed.

3. Grants may be made to residents of any country, but preference will be given to residents of America.

4. Grants of sums of $500 or less are favored, but larger appropriations may be made. In some cases appropriations may be guaranteed for several years in advance.

5. Grants as a rule will be made for work which could not be done or would be very difficult to do without the grant. A grant will not ordinarily be made to defray living expenses.

6. The committee will not undertake to supervise in any way the work done by those who receive the grants. Unless otherwise provided, any apparatus or materials purchased will be the property of the individual receiving the grant.

7. No restriction is made as to publication, but the recipient of the grant should in the publication of his work acknowledge the aid given by the fund.

8. The recipient of the grant is expected to make to the secretary of the committee a report

in December of each year while the work is in progress, and a final report when the work is completed and published. Each report should be accompanied by a financial statement of expenditures, with vouchers for the larger items when these can be supplied without difficulty.

9. The purposes for which grants are made and the grounds for making them will be published.

At least once each year announcement is made in SCIENCE inviting applications and suggestions for grants. Although this procedure naturally results in the receipt of a considerable number of requests for support of work which is trivial or scientifically unsound, it is also true that members of the committee have in this way learned of various places where small expenditures would produce valuable results, both by direct aid to struggling investigators and by bringing to the attention of authorities of institutions the importance of some of the work which is being carried on by members of their staffs.

Each person who accepts a grant signs an agreement to the following conditions:

(1) The work as outlined will be begun in the near future and efforts will be made to complete it at as early a date as possible.

(2) A report will be made to the secretary of the committee on the completion and publication of the work, and in December of each year until the work is completed. The reports will include a financial statement with vouchers for the larger items.

(3) In the publication of the results the grant from the research fund of the American Association for the Advancement of Science will be acknowledged.

Shortly before December 1 of each year the secretary of the committee sends out a reminder to each recipient of a grant that a report is due, and a list of these reports is kept in the files of the committee. By a vote of the committee the account of each grant is kept open until it is formally closed by action of the chairman, secretary, and member of the committee in whose field the grant lies. Every grant is thus followed up until the work is completed and published.

As the committee was organized just prior to the entrance of the United States into the war, there was considerable delay at first, during 1917 and 1918, in getting the work of the different grants started. In fact, some of the assignments were returned because the work was postponed on account of the war, and other investigations have not yet been brought to conclusion for the same reason.

In the following table is given a summary of the grants that have been made during the past five years together with a summary of the present state of the accounts, and there is given as an addendum to this report a detailed list of the different grants which have been made:

Year	Amount apportioned	Number of Grants	No. of Grants for Which Work is Completed	No. of Grants for Which Work is Completed and Published	No. of Papers Published
1917	$ 2,350	14	9	6	10
1918	2,900	9	6	5	12
1919	4,000	16	9	5	12
1920	4,500	19	9	4	3
1921	5,000	24	3	2	2
Totals	$18,750	82	36	22	39

Most scientific men will no doubt agree that the only test as to whether or not a given investigation is successful, is the actual publication of the results. The last column in the foregoing table shows how many papers have thus far been published as wholly or in part due to grants from the association for the corresponding year. In the second addendum to this report is given a bibliography of these papers. This list is growing rapidly, and as time goes on it will present a real measure of the success of the work of the committee and of the policy of the association.

Respectfully submitted,

JOEL STEBBINS,
Secretary, Committee on Grants
UNIVERSITY OF ILLINOIS,
DECEMBER, 22, 1921

First Addendum

LIST OF APPROPRIATIONS MADE BY THE COMMITTEE ON GRANTS, 1917-1921

1917

1. Ralph C. Benedict, Brooklyn, New York. Botany. For the continuation of the investigation on the Boston fern..... $100
2. R. S. Woodworth, Columbia University. Psychology. For compiling anthropometric data..... 100

3. F. C. Blake, Ohio State University, Physics. In aid of his work on electric waves 100

4. Richard C. Tolman, Fixed Nitrogen Research Laboratory, Washington, D. C. Physics. For further testing and extending his work on the electromotive force produced in a conductor subjected to mechanical acceleration..... 300

5. H. L. Fairchild, University of Rochester. Geology. To defray traveling expenses in a study of the post-glacial land uplift in New England and the maritime provinces of Canada..... 300

6. S. W. Williston, University of Chicago, Geology. Toward the expenses of an artist to help draw the figures of the many new Permian fossil vertebrates which Dr. Williston discovered..... 100

7. Ralph W. Chaney, State University of Iowa. Geology. Toward field expenses of further studies upon the Eagle Creek flora of the Columbia River gorge..... 100

8. Frederick P. Gay, University of California. Pathology. For animals and materials to be used in the study of the specific treatment of tuberculosis in animals, especially in the use of taurine derived from the muscles of certain shell fish..... 500

9. John B. Watson, Johns Hopkins University. Psychology. Toward the study of the development of the reflexes and instincts of infants..... 100

10. Robert M. Yerkes, Harvard University. Psychology. Toward the cost of apparatus and care of animals in the study of ideational behavior. (Returned) 100

11. Ales Hrdlička, U. S. National Museum. Anthropology. For anthropometrical investigations on the tribe of Shawnee in Oklahoma..... 100

12 Bruno Oetteking, Museum of the American Indian, New York. Anthropology. For the purpose of completing the investigation of skeletal material from the Pacific coast of America 100

13. Herbert M. Richards, Barnard College. Botany. For the continuation of the investigation of the physiology of succulent plants..... 250

14. C. H. Kauffman, University of Michigan. Botany. To aid in his studies of the fungus genus *Cortinarius*..... 100

1918

15. American Association of Variable Star Observers. Astronomy. For the purchase of a telescope of 5-inch aperture 300

16. A. E. Douglass, University of Arizona. Botany. For determining the record of the Sequoias..... 250

17. C. H. Eigenmann, Indiana University, Zoology. For the study of the fresh water fishes of South America..... 500

18. Edwin B. Frost, Yerkes Observatory. Astronomy. For the measurement and reduction of stellar spectrograms..... 500

19. R. A. Porter, Syracuse University. Physics. For the explanation of the hysteresis which has been observed in the potential gradients of the calcium-cathode vacuum tube..... 200

20. E. W. Sinnott, Connecticut Agricultural College. Botany. For experiments to determine the ratio between root, stem, leaf and fruit in the bean plant 200

21. O. F. Stafford, University of Oregon. Chemistry. For research on the distillation of wood 500

22. Herman L. Fairchild, University of Rochester. Geology. For the continuation and completion of his studies on the post-glacial continental uplift in New England and the maritime provinces of Canada. (Additional)..... 200

23. Seismological Society of America. Geology. To enable the society to dispatch capable men to study the phenomena of earthquakes as promptly as possible after their occurrence..... 250

1919

24. Edwin B. Frost, Yerkes Observatory. Astronomy. For the measurement and reduction of stellar spectrograms. (Additional) 500

25. A. L. Foley, Indiana University. Physics. For experiments on the speed of sound very close to the source..... 150

26. Orin Tugman, University of Utah. Physics. To determine the change of conductivity in a thin metallic film when exposed to ultra-violet light..... 100

27. E. M. Terry, University of Wisconsin. Physics. For work on the modulation of radio-energy employed in wireless telephony 150
28. F. C. Blake, Ohio State University. Physics. In aid of his work on electric waves. (Additional) 100
29. Gerald L. Wendt, University of Chicago. Chemistry. For the investigation of the photo-chemical reactions of hydrogen and chlorine 350
30. Seismological Society of America. Geology. For the investigation of earthquake phenomena. (Additional) 250
31. Roy L. Moodie, College of Medicine, University of Illinois. Geology. For the preparation of sections of fossil bones which show lesions of ancient disease, and for the making of photomicrographs of these sections 200
32. C. H. Eigenmann, Indiana University, Zoology. To defray part of the expenses of the Irwin expedition to western South America. (Additional) 500
33. P. W. Whiting, St. Stephens College. Zoology. For investigations on the Mediterranean flour-moth and its hymenopterous parasite, *Hadrobracon* 200
34. *Botanical Abstracts.* Botany. For aid in establishing this new and important periodical 500
35. Gilbert M. Smith, University of Wisconsin. Botany. For aid in a study of the plankton of the lakes of southwestern Ontario 100
36. Ales Hrdlička U. S. National Museum. Anthropology. For *The Amerian Journal of Physical Anthropology* 200
37. Myra M. Hulst, Washington, D. C. Social Science. For investigations into the mortality of graduates from American colleges for women 200
38. Leslie B. Arey, Northwestern University Medical School. Medicine. In support of his study of the origin, growth and fate of the giant cells, or osteoclasts, usually held responsible for bone dissolution 400
39. S. A. Courtis, Detroit, Michigan. Education. Toward the expenses of securing a comparison based upon a survey of Boston schools in 1845 with present-day schools from Maine to California 100
40. Solomon Lefschetz, University of Kansas. Mathematics. To assist in the publication of his memoir on algebraic surfaces, which was awarded the Bordin prize of the Paris Academy of Sciences 300
41. Olive C. Hazlett, Mount Holyoke College. Mathematics. In support of her work on the theory of hypercomplex numbers and invariants 100
42. A. A. Knowlton, Reed College. Physics. In aid of a determination of the relation between chemical composition and magnetic properties in Heusler alloys 200
43. John C. Shedd, Occidental College. Physics. In aid of a further study of snow crystals, similar to that which he has already published 100
44. Philip Fox, Dearborn Observatory. Astronomy. In support of his work on the photographic determination of stellar parallaxes 600
45. Anne S. Young, Mount Holyoke College. Astronomy. For the determination of the positions and proper motions of stars from photographic plates already taken 100
46. Ferdinand Canu, Versailles, France. Geology. To carry forward completion his studies upon the classification of bryozoa 250
47. Frank B. Taylor, Fort Wayne, Indiana. Geology. For a field study of the moraines of recession in the St. Lawrence Valley 250
48. S. I. Kornhauser, Denison University. Zoology. For a continuation of his work on the sexual characteristics of the membracid insect *Thelia bimaculata* 250
49. P. W. Whiting, St. Stephens College. Zoology. For breeding outfit and temperature apparatus to be used for genetic and cytological researches on *Ephestia* and *Hadrobracon* 200
50. *Botanical Abstacts.* Botany. For editorial and office expenses in connection with the preparation of manuscripts. (Additional) 500
51. I. W. Bailey, Bussey Institution. Botany. For an investigation upon: (1) Myrmecophytism; (2) Relations between ants and fungi; (3) Cytology of the cambium 500

52. S. D. Robbins, Boston, Massachusetts. Psychology. For a study of a trephined stammerer 100

53. Daniel W. LaRue, Stroudsburg State Normal School, Pennsylvania. Education. In support of experimental work on a phonetic alphabet..... 200

54. Margaret F. Washburn, Vassar College. Psychology. For a study of emotional characteristics of certain racial groups in New York City..... 200

55. Joseph Peterson, George Peabody College for Teachers. Psychology. In support of a study of the qualitative differences in the mentality of whites and negroes 200

56. A. A. Schaeffer, University of Tennessee. Psychology. In support of an experimental study of orientation and the direction of movement of animals, and particularly of th "spiral path" in man 200

57. Theodore Hough, University of Virginia. Physiology. In support of his studies with Dr. J. A. Waddell on blood changes after severe hemorrhages. (Returned) 100

58. Carl J. Wiggers, Western Reserve University. Physiology. In support of his investigations of the cardiac function by optical registration..... 150

1921

59. Solomon Lefschetz, University of Kansas. Mathematics. In support of his work in algebraic geometry..... 150

60. Gerald L. Wendt, University of Chicago. Chemistry. For the purchase of apparatus for investigations at high temperatures. (Additional)..... 200

61. Graham Edgar, University of Virginia. Chemistry. For the purchase of a quartz mercury arc lamp for research in photo-chemistry..... 200

62. Sebastian Albrecht, Dudley Observatory. Astronomy. In support of his investigation of the variation of wavelength of lines in different types of stellar spectra 200

63. Caroline E. Furness, Vassar College Observatory. Astronomy. For assistance in the measurement and reduction of photographic plates 200

64. Frank B. Taylor, Fort Wayne, Indiana. Geology. For a field study of the moraines of recession in the St. Lawrence Valley. (Additional)..... 300

65. Seismological Society of America. Geology. For the investigation of earthquake phenomena. (Additional)..... 200

66. P. W. Whiting, St. Stephens College. Zoology. To add to his microscopic equipment for the study of genetics in insects. (Additional) 200

67. N. A. Cobb, Falls Church, Virginia. Zoology. For aid in a series of researches into the physiology of the cell, or to defray cost of publication of results already on hand..... 450

68. George B. Rigg, University of Washington. Botany. For work on the sphagnum bogs of the Puget Sound region 300

69. J. M. Greenman, Missouri Botanical Garden. Botany. In part payment of expenses of a collecting trip to Central America..... 500

70. T. R. Garth, University of Texas. Psychology. For a psychological study of Indian children in the United States schools at Chilocco, Oklahoma, and Albuquerque, New Mexico..... 150

71. E. G. Boring, Clark University. Psychology. For the preparation of a set of steel acoustic cylinders to be used in determining the nature of sensory response under conditions of normal psychometric situation 150

72. A. L. Kroeber, University of California. Anthropology. For bibliographical and clerical assistance in connection with an ethnological investigation to determine the culture areas of aboriginal South America..... 200

73. Helen H. Roberts, New York City. Anthropology. For a study of negro folk music in Jamaica..... 150

74. Frank A. Hartman, University of Buffalo. Physiology. To aid in the study of suprarenal insufficiency..... 150

75. W. E. Garrey, Tulane University, Physiology. For the puchase of apparatus for hydrogen-ion determinations..... 200

76. Frank P. Knowlton, Syracuse University. Physiology. To aid in the study of the blood flow and gaseous metabolism of the thyroid gland..... 150

77. Carl J. Wiggers, Western Reserve University. Physiology. In support of his investigations of the cardiac function by optical registration. (Additional) 150

78. W. F. G. Swann, University of Minnesota. Physics. For investigation of electric phenomena in the upper atmosphere 150

79. H. M. Randall, University of Michigan. Physics. In support of his study of rotational spectra of gases obtained by absorption..... 250

80. Walter G. Cady, Wesleyan University. Physics. In support of his study of electrical reactions by piezo-electric crystals in high frequency circuits..... 200

81. Paul F. Gaehr, Wells College. Physics. In support of his work on specific heat of tungsten at incandescent temperatures 100

82. A. L. Foley, Indiana University. Physics. For experiments on the speed of sound very close to the source. (Additional)..... 100

Second Addendum

LIST OF PAPERS REPORTING WORK SUPPORTED BY APPROPRIATIONS FROM THE COMMITTEE ON GRANTS

(To December 31, 1921)

American Association of Variable Star Observers. Observations by C. Y. McAteer in monthly reports. *Popular Astronomy*, Vols. 27-29, 1919-1921.

Arey, Leslie E. The origin, growth and fate of osteoclasts, and their relation to bone resorption. *American Journal of Anatomy*, 26: 315-346, 1920.

Benedict, Ralph C. The origin of new varieties of *Nephrolepsis* by orthogenetic saltation. Progressive variations. *Bulletin Torrey Club*, 43: 297-234, 1916.

Blake, F. C. On the effective capacity and resistance of a condenser for high frequency currents. *Physical Review*, 16: 540-557, 1920.

On electrostatic transformers and coupling coefficients. *Journal of the American Institute of Electrical Engineers*, 40: 23-29, 1921.

Chaney, Ralph W. The flora of the Eagle Creek formation. *Contributions from Walker Museum*, 2: No. 5, 115-181, 1920.

Cobb, N. A. *Contributions to a science of nematology*, IX: 217-343, 1921.

Douglass, A. E. Climatic cycles and tree growth. *Carnegie Institution of Washington, Publication* No. 289, pp. 127, 1919.

Eigenmann, Carl H. The Irwin Expedition to Peru, Bolivia and Chile. *Indiana University Alumni Quarterly*, January, 1920, pp. 20.

The fishes of Lake Valencia, Caracas, and of the Rio Tuy at El Concejo, Venezuela. *Indiana University Studies*, 7: No. 44, 1-13, 1920.

South America west of the Maracaibo, Orinoco, Amazon and Titicaca basins, and the horizontal distribution of its fresh water fishes. *Indiana University Studies*, 7: No. 45, 1-24, 1920.

The fishes of the rivers draining the western slope of the Cordillera Occidental of Colombia, Rios Atrato, San Juan, Dagua and Patia. *Indiana University Studies*, 7: No. 46, 1-19, 1920.

The fish fauna of the Cordillera of Bogota. *Journal of the Washington Academy of Sciences*, 10: No. 16, 1920.

The fresh water fishes of Panama east of longitude 80° W. The Magdalena basin and the horizontal and vertical distribution of its fishes. *Indiana University Studies*, 7: No. 47, 1-34, 1920.

The origin and distribution of the genera of the fishes of South America west of the Maracaibo, Orinoco, Amazon and Titicaca basins. *Proceedings of the American Philosophical Society*, 60: 1-6, 1920.

The American characidæ. *Memoirs of the Museum of Comparative Zoology, at Harvard College*, 48: Part 3, 209-319, 1921.

Fairchild, Herman L. Post-glacial continental uplift. SCIENCE, 47: 615-617, 1918.

Glacial depression and post-glacial uplift of northeastern America. *Proceedings of the National Academy of Sciences*, 4: 229-232, 1918.

Post-glacial uplift of northeastern America, *Geological Society of America Bulletin*, 29: 187-238, 1918.

Post-glacial sea-level waters in eastern Vermont. *Report of the Vermont State Geologist for 1917-1918*, 52-75, June, 1919.

Pleistocene marine submergence of the Hudson, Champlain and St. Lawrence valleys. *The New York State Museum Bulletin*, Nos. 209-210 (May-June, 1918), April, 1920.

Post-glacial uplift of southern New England. *Geological Society of America Bulletin*, 30: 597-636, 1920.

Foley, A. L. A photographic method of finding the instantaneous velocity of spark waves. *Physical Review*, 16: 449-463, 1920.

Garrey, W. E. The relation of respiration to rhythm in the cardian ganglion of *Limulus polyphemus*. *Journal of General Physiology*, 4: 149-156, 1921.

Gay, Frederick P. The treatment of experimental tuberculosis in guinea-pigs and rabbits by taurin, alone and in combination with gold chlorid and sodium oleate (by M. Takeoka). *Journal of Infectious Diseases*, 20: 442-456, 1917.

A method for the preparation of taurin in large quantities (by C. L. A. Schmidt and T. Watson). *Journal of Biological Chemistry*, 33: 499, 1918.

On the elimination of taurin administered to man (by C. L. A. Schmidt, E. von Adelung and T. Watson). *Journal of Biological Chemistry*, 33: 501, 1918.

Hrdlička, Ales. The vanishing Indian. Science, 46: 266-267, 1917.

Kornhauser, S. I. The cytology of the sea-side earwig, *Anisolabis maritima* Bon. *Denison University Bulletin, Journal of the Scientific Laboratories*, 19: 234-246, 1921.

Moodie, Roy L. Concerning the fossilization of blood corpuscles. *American Naturalist*, 54: 460-464, 1920.

Ancient bacteria and the beginnings of disease. *Scientific Monthly*, October, 1920.

Microscopic examination of a fossil fish brain. *Journal of Comparative Neurology*, 32: 329-333, 1920.

A variant of the sincipital T in Peru. *American Journal of Physical Anthropology*, 4: 219-222, 1921.

Porter, R. A. The relation of potential distribution to hysteresis effect in the Wehnelt tube. *Physical Review*, 13: 189-196, 1919.

Robbins, Samuel D. A plethysmographic study of shock and stammering in a trephined stammerer. *American Journal of Physiology*, 52: 1-24, 1920.

Seismological Society of America. The San Jacinto earthquake of April 21, 1918 (by S. D. Townley and others). *Bulletin Seismological Society of America*, 8: 45-73, 1917.

The Inglewood earthquake in southern California, 1920, June 21 (by Stephen Taber). *Bulletin Seismological Society of America*, 10: 129-143, 1920.

Watson, J. B. *Psychology from the standpoint of a behaviorist*, Lippincott, 1919. Summary of work in Chapters VI, VII and VIII.

Wendt, Gerald L. Triatomic hydrogen (with R. S. Landauer). *Journal of the American Chemical Society*, 42: 930-946, 1920.

Young, Anne S. Proper motions of certain long-period variable stars. *Astronomical Journal*, 33: 194, 1921.

THE ELEMENTARY COURSE IN GENETICS[1]

The elementary courses in botany and in zoology have recently been the subject of considerable discussion. One might think that subjects as old and as well established as these which have been taught for many years should long ago have become definitely organized upon the proper pedagogical basis. But these subjects with their various subdivisions have grown so large that it is becoming increasingly difficult to give adequate treatment even in an elementary manner to all phases of either of these two primary biological sciences in the time that is ordinarily available for the beginning course. Teachers of these subjects are, therefore, confronted with the choice of making the beginning course an elementary survey of the entire field of their subject or of bodily eliminating certain phases, leaving their consideration to later and more specialized courses.

Genetics may properly be regarded as one of these subdivisions or phases of biology—a phase of applied biology if you will. But it can not properly be regarded as a phase either of botany or zoology alone, nor can it be adequately treated in a course of instruction by confining one's attention exclusively to one or the other kingdom. The genetics instructor must be free to select his illustrative material from any source, plant or animal, economic or non-economic, as he sees fit. While the greater number of forms of animal life of economic importance are to be found among mammals, birds and fishes, and of plants among the

[1] Paper No. 95, Department of Plant Breeding, Cornell University, Ithaca, New York. Read before the Conference of Geneticists interested in agriculture at the Toronto meeting of the American Association for the Advancement of Science.

angiosperms, certainly much of our collateral evidence in genetics comes from the lower forms of both kingdoms. An adequate treatment of the subject of genetics can not be had under any system of administrative organization which insists upon the drawing of hard and fast departmental lines or in any environment which limits the instructor to the consideration of either wild or domesticated forms of life. In my judgment genetics falls in the same category as cytology and evolution in which the best instruction can not be given without the opportunity of free and unrestricted choice of illustrative material and evidence from both plant and animal life.

Although the science of genetics is by no means as old as that of botany or zoology, its growth and development has been and continues to be of such magnitude that we are rapidly approaching the same state of affairs that confronts the botanist and zoologist. The elements of genetics in all of their details are already extensive and numerous and it is becoming increasingly difficult adequately to treat all phases of the subject even in an elementary way in a single course without making it of unreasonable length. The genetic instructor must, therefore, decide what subject matter is relevant to the object of his course and what is irrelevant and of the former determine what phases may reasonably be left to courses in other biological sciences which may be made prerequisite to the elementary course in genetics and what may well be left for advanced courses in genetics. I confess that the problem of how far to go in the elementary course and what to leave for the advanced course is at times a most perplexing question.

In order to reach the proper decision, we must first define our objective. What is the purpose of the elementary course in genetics? What is its objective? Upon the answer to these questions must our method of procedure necessarily depend. It seems to me that any course worthy of collegiate recognition and standing must be primarily cultural in nature and secondarily informational. It is, however, not impossible to combine these two purposes in any course of instruction even in the professional school, but judging from the array of courses offered by some departments in some of our agricultural colleges one may wonder if the presentation of encyclopedic information rather than the training of students to do independent and original thinking is not the end attained even though it may not be the objective sought. I wonder if we instructors in agricultural colleges do not sometimes make the mistake of thinking that the agricultural student is not interested in anything that has no direct connection with agricultural phenomena and that it is necessary to sugar coat the pill by giving our courses an agricultural flavor. I admit that we have some students of this type but I believe that they constitute a small minority of the student body, at least at the beginning of their college course. If, however, many of the courses which students find in the agricultural college are largely informational in nature, it is not at all strange that some should regard a modern course in genetics as highly theoretical and of little practical application. When I recall that many of our most successful farmers representing our highest type of rural citizenship are not agricultural college graduates, I wonder if we have perhaps not over emphasized the value of an agricultural course as contrasted to courses in the so-called pure sciences, languages and the humanities even for the man who expects to spend his life and make his living on the farm. I do not underestimate the value of the information he gets in technical agricultural courses but I question if the time that the student is often required to spend in getting this information is proportional to the amount of real and useful information that he gets. One of my colleagues in one of our technical departments recently said to me, "We can give our students all that we know that will actually work on the farm in our field in a three-hour course." Yet I hazard the guess that if you will examine the announcements of courses of departments in this field in our various agricultural colleges, you will find in most of them a relatively large array of detailed courses offered. Where this situation prevails the student is forced to spend an excessive amount of time to get what I am firmly convinced in many cases could be consolidated into much fewer hours if the subject matter

were more concentrated. Furthermore, better teaching would result if courses were designed for the purpose of real mental training rather than for the purpose of giving out a lot of half digested facts, some good, many bad, for absorption by the student to be handed back often in the same undigested form at examinations.

Granting that the primary object of the agricultural college is the training of men and women for farm life, I wonder if we would not be doing that better were we to give in our courses of instruction less consideration to the presentation of information and more to the development of the habit and desire for real thinking. We may well leave the acquisition of some of this information to the student himself if we will acquaint him with the literature of the subject and train him properly to appraise the value of such information as is available and how to use it after he has obtained it.

The teaching of genetics in the agricultural college affords an excellent opportunity for the accomplishment of these aims. If the course is properly organized and presented no student can successfully grasp and assimilate such a body of knowledge without some real mental effort on his part.

I would, therefore, define the objective of the elementary course in genetics as primarily cultural and secondarily informational. If proper consideration be given to its cultural value, it should be of like interest to the student of general biology who expects to go no farther into this field of human knowledge but who desires a general understanding of the phenomena of inheritance, to the student of eugenics and sociology who wants a genetic background for further studies in those fields, to the student who is beginning his special or professional training in genetics or to the student who is specializing in any of the plant or animal industry departments and who desires a genetic training as a basis for plant and animal improvement.

From the informational point of view the general student is not at all interested in a genetic analysis of aleurone color in maize or eye color in Drosophila. The same is probably true of the agronomist or animal husbandman. But an understanding of the phenomena involved in the inheritance of such characters and a knowledge of the mode of attack that has been used in the solution of such problems will be helpful and useful to all and will give to students of applied genetics a better appreciation of the complexity of the mode of inheritance of other characters that are of economic importance and with which as plant and animal breeders they are vitally concerned.

PREREQUISITES

In order to deal with the subject of genetics even in the elementary course in an adequate and satisfactory manner, it is essential that the student have the proper biological background. For the advanced student in genetics a thorough training in either botany or zoology and an elementary training in the other of these sciences is essential but this seems hardly necessary in the beginning course. A sufficient biological training as prerequisite for elementary genetics would seem to be had in a general course in botany or zoology and one in physiology. An elementary knowledge of cytology is, of course, important but the genetics instructor should be able to supplement by lecture or reference without difficulty or without much expense of time such instruction as the student ordinarily gets in cytology in the beginning courses in botany and zoology as may be necessary to an elementary knowledge of the mechanism of heredity.

Certain courses in mathematics are also advisable for the advanced student of genetics but are perhaps not essential for the beginner. The one thing that is essential in my judgment is that the student shall not have forgotten his high school mathematics nor have forgotten how to think and reason in mathematical terms —a condition which too often prevails among students in the agricultural college.

OF WHOM REQUIRED

Of what students in the agricultural college should genetics be required? When I think of my own course I am tempted to answer, of none. I am sure that we would all agree that it is much more satisfactory to work with a class of students all of whom are registered because they want that particular course than because the faculty has ruled that they must

have it before they will be graduated or because some professor has said they must have it before they may take his course. Since I insist upon the privilege of saying that my own students shall have botany or zoology and physiology before they take genetics, I can not well quarrel with a colleague who makes similar requirements of my course as a prerequisite for his.

Perhaps we would all agree that an elementary knowledge of genetics is of value to all agricultural students. But so are courses in many other subjects. If a student were required to have even an elementary knowledge of every thing that is good for him there would be little time left for advanced or specialized courses in any subject. It does seem advisable, however, that as a rule students specializing in any phase of biology should have a course in genetics, though I doubt the advisability of making it a fixed requirement for all. If any group of students should be required to have genetics, it should be those who will later be engaged in the production of better plants and animals and then only in the sense of making it the basis for courses dealing with the application of genetic principles to plant and animal improvement. I am not at all in sympathy with making genetics a requirement for graduation of all students in the agricultural college any more than with making plant or animal breeding such a requirement.

RELATION TO COURSES IN TECHNICAL DEPARTMENTS

Notwithstanding my conviction that the genetics instructor will get better results on the whole if his course is not required, from the standpoint of instruction in the technical departments of plant and animal industry as well as from the standpoint of educational and administrative policy, it would seem important that at least an elementary knowledge of genetics should be made prerequisite to courses in plant and animal breeding if the latter are to be more than a presentation of empirical rules and methods or a consideration of superstitious practices and beliefs. If the genetics course is made prequisite to such courses the instructor of the latter will have a definite basis upon which to work and will not be forced to spend his time in a consideration of genetic principles as an introduction to the main part of his course—a tiresome review for those of his students who have previously taken the course in genetics and an inadequate consideration of genetics for those who have not. Time will thus be saved for both instructor and student and better work will be done.

I offer no apologies for the materials of the genetics instructor. Nevertheless, in an agricultural college at least one always encounters a few students of an intensely practical mind, to whom I have already referred, who seem to have little interest in matters not of immediate economic importance or application. Such students one of my colleagues has described as "those who desire information without knowledge." If left to their own inclinations and desires they are apt to fill up their schedule with what may be termed "informational" courses to the exclusion of courses that require real mental work. It is sometimes possible to command a greater interest on the part of such students by giving careful thought to the choice of illustrative material, by pointing out from time to time some applications of genetic principles in plant and animal improvement and by referring such students to literature illustrating the very practical use of genetic knowledge in the interpretation of phenomena with which they are quite familiar.

SCOPE AND CONTENTS

In my judgment, the elementary course in genetics should constitute a survey of the entire field of heredity. It should be organized and presented in such a manner as to acquaint the student not only with a knowledge of the principles and facts of heredity but of how the science of genetics has been and is being developed, and give him an elementary knowledge of the modes of genetic research. Genetics offers an excellent opportunity for the teacher to present his subject from the research point of view and to demonstrate how human knowledge is advanced. I am inclined to think agricultural students in general get too little of this type of instruction.

Perhaps I can best illustrate the scope and

contents of such a course as I have attempted to describe by briefly outlining our own elementary course in genetics. In doing so, I have no exaggerated idea of the importance of its organization or contents. In fact, we are by no means satisfied with it ourselves and are continually changing it from year to year. Nevertheless, for our conditions, it seems to work fairly well as it now stands. It consists of three lectures and one laboratory period a week for a term of sixteen weeks.

Plant Breeding 1—Genetics

1. The methods, problems, scope and relationships of genetics. Relation to evolution, to plant and animal breeding, and to eugenics.
2. Early theories of development and heredity. Preformation and predelineation.—Epigenesis.—Spencer's physiological units.—Darwin's pangenesis.—Naegeli's micellæ.—DeVries' intracellular pangenesis.—Weismann's theory of heredity.
3. The pioneer plant hybridizers.
   Camerarius' demonstration of sexuality in plants.—The first plant hybrid.—The first extensive series of plant hybridization experiments by Kölreuter, his results and conclusions.—Other early plant hybridizers and their contributions: Thomas Knight and John Goss—the "splitting" of hybrids; Wiegmann and Sageret—the existence of characters in contrasted pairs and the frequent suppression in the hybrid of one parental form by that of the other.—Von Gärtner and his classification of hybrids as intermediate, comingled and decided.—Naudin and his principle of the segregation of species potentialities.
4. Gregor Mendel—the greatest of plant hybridizers.
   Choice of material.—Methods used and characters studied.—Results in first and second generation hybrids with (*a*) one character pair, (*b*) two character pairs.
5. The essential features of Mendel's hypothesis.
   Independent inheritance of single characters.—Alternative forms of single characters (allelomorphism).—Dominance and recessiveness.—Segregation and the purity of the germ cells.—Recombination.
6. Mendel's methods of testing his hypothesis. Behavior in subsequent generations.—Backcrossing the hybrids to the parental forms.
7. Definition and illustration of Mendelian terms. Gamete, zygote, homozygote, heterozygote, genotype, phenotype, P_1, F_1, F_2, F_3, etc.
8. Further illustration of Mendelian inheritance and the calculation of Mendelian expectancies.
   Mono-, di- and trihybrids with and without dominance.—Backcrossing heterozygotes to simple, double and triple recessives.—Algebraic and checkerboard methods of calculation.
9. The mechanism of Mendelian heredity.
   Brief evidences for the chromosome theory of heredity.—Behavior of the chromosomes in mitosis.—Heterotypic and homotypic divisions.—Parallelism of Mendelian segregation and chromosome segregation.—Chance and probability in inheritance.—Points at which chance is operative.
10. Interaction of factors.
    Interaction of allelomorphic factors: heterozygous or "unfixable" characters—pink Mirabilis, double carnation; homozygous dominant lethal—the yellow mouse, yellow snapdragons, dichaete Drosophila, etc.—Interaction of non-allelomorphic factors: appearance of new or old characters with normal Mendelian ratios—comb form in fowls, plant color in maize; appearance of new or old characters with modified Mendelian ratios such as 9:3:4, 9:7, 13:3, 27:9:28, 27:37, 27:9:9:3:9:7, etc.—Duplicate and triplicate genes, 15:1 and 63:1 ratios.
11. Sex inheritance and sex determination.
    The chromosome theory of sex inheritance: cytological evidence; sex-linked inheritance; evidence from parthenogenesis; miscellaneous evidences; attempts at sex control.—Sex inheritance in plants: mosses, ferns and liverworts; diœcious forms among the spermatophytes.—Sex intergrades and gynandromorphs: Mercurialis; gypsy moth; Drosophila, etc.
12. The physiological basis of sex determination. Hormones of sex glands and their effect upon the development of secondary sexual characters.—Effects of castration and transplation of gonads.—Effects of nutrition.

13. The principle of associative inheritance—linkage.
    Discovery by Bateson in sweet peas.—Elaboration by Morgan and others in Drosophila.—Extension to other plants and animals by various workers.—The chiasma-type theory as an explanation of the mechanism of linkage and crossing over.—Illustrations of various linkage phenomena.
14. The inheritance of quantitative characters.
    The facts.—The interpretations that have been offered.—The multiple factor hypothesis.
15. The statistical study of variation.
    Calculation and uses of the ordinary biometrical constants.
16. Correlation.
    Calculation and uses of the coefficient of correlation.
17. The pure line concept.
    Johannsen's selection experiments and conclusions.—Confirmation and extension by other workers.
18. The role of selection in plant and animal breeding.
    Effect of selection in populations of self-fertilized and cross-fertilized plants and with animals under various systems of mating.—Selection from the point of view of the animal breeder.—Modifying factors.
19. Inbreeding and outbreeding.
    The conflict of views.—Experimental evidence in both plants and animals.—Interpretation of the results of inbreeding.—Heterosis and its utilization in plant and animal production.
20. Non-Mendelian inheritance.
    Cytoplasmic and maternal inheritance.—Chimeras.
21. The mutation concept.
    The DeVriesian view.—The modern view.—Point or factor mutations and multiple allelomorphs.—Regional mutations.—Chromosome aberrations.—Bud variations.—Attempts to induce mutations.
22. The mode of evolution from the mutation point of view.
23. Eugenics.
    The application of genetic principles to race improvement.—Limitations.

C. B. HUTCHISON
CORNELL UNIVERSITY

LAMARCK, MIRBEL AND THE CELL THEORY

IT seems to have escaped the notice of writers of text books on biology and the history of science, even in France, that the cell theory in broad outlines was taught in Paris at the very opening of the nineteenth century, forty years before Schleiden and Schwann published their famous epoch-making work.

Lamarck stated clearly in his "Philosophie Zoologique," 1809, that all plants and animals are composed essentially of cellular tissue, without which "no living body would be able to exist nor could have been formed." "Since 1796," he says, "I have been accustomed to set forth these principles in the first lessons of my course."

Lamarck's clear and positive statement of the fundamental importance of cellular tissue, like his theory of evolution, unfortunately was not supported by an array of well authenticated published facts. Lamarck's conception was that cellular tissue (epidermal and connective), enclosing the organism and its parts, is the matrix in which the fluid living matter is shaped into organs, by physico-chemical forces acting upon it from without.

Mirbel, his younger colleague at the museum, adopted the cellular tissue theory, and brought to its support from the field of botany a splendid body of facts, to which long afterwards both Schleiden and Schwann allude. To Mirbel plants are made of a folded membranous cellular tissue, with slow circulation of fluid among the cells through intervening pores.

Dutrochet, in 1824, introduced into the theory the idea of the individuality of the cell, of which all plants and animals are composed, but unfortunately he had no standard by which to decide what is, or what is not, a cell in the animal. The universally present nucleus had not yet been discovered and the cell thus, so to speak, standardized. Hence in matters of detail, he went somewhat astray, but he was a most enthusiastic supporter of the cell theory as he knew it.

Robert Brown, as a by-product of a work on fertilization in Orchids and Milkweeds, described the universal occurrence of cell nuclei.

This made the cell theory of Schleiden and Schwann a possibility.

Without detracting at all from the epoch-making work of these two men, and with great admiration for that of Schwann, who accurately described for the first time many types of animal cells, the present writer finds himself unable to give them sole credit for a theory that had been taught forty years earlier in France.

Not one of these pioneers knew how new cells originate. It was the deep secret that most intrigued the active minds of the two Germans. They made their guess, and guessed wrongly, but their observations in confirmation of Robert Brown's important discovery, and Schwann's clear pictures of animal cells, have given them the distinguished place that they deserve among the founders of the cell theory. Whether they should be given exclusive credit for the theory that had been taught in Paris forty years earlier by Lamarck, and admirably supported by beautiful plates prepared by Mirbel showing plant structures, the reader may judge for himself by reading a review of the whole situation in the current number of *The Scientific Monthly*[1], and, better, by perusing the original books and papers to which reference is therein made.

Reviewed now, after the lapse of a century, the different methods and temperaments of the various writers are thrown into bold relief, and one is forcibly reminded of the folly of unchecked speculation and the wisdom of guarding the indispensable imagination by keen, untiring observation and experiment.

John H. Gerould
Dartmouth College

SCIENTIFIC EVENTS

DISINTEGRATION OF ELEMENTS[1]

I have been asked to say a few words about a telegram in the *Times* of March 14 giving an account of a paper communicated to the American Chemical Society at Chicago by Dr. G. Wendt and Mr. C. E. Iron. It reported that, when a powerful condenser discharge at 100,000 volts was sent through a very fine tungsten wire, the filament exploded with a "deafening report," producing a flash estimated to correspond to a temperature of at least 50,000° F. The telegram states: "After the flash he (Dr. Wendt) found atoms of tungsten decomposed into simpler atoms and the result was the change of metallic tungsten into gaseous helium." The experiments were made to investigate whether any atomic disintegration can be effected by such high temperature discharges, and apparently the authors believe that they have obtained positive results.

We must await a much fuller account of the experiments before any definite judgment can be formed; but it may be of interest to direct attention to one or two general points. During the last ten years many experiments have been recorded in which small traces of helium have been liberated in vacuum tubes in intense electric discharges, and it has been generally assumed that this helium has been in some way occluded in the bombarded material. On modern views, we should anticipate that the disintegration of a heavy atom into lighter atoms, *e. g.*, into atoms of helium, would be accompanied by a large evolution of energy. Indeed, it is to be anticipated that the additional heating effect due to this liberated energy would be a much more definite and more delicate test of disintegration of heavy atoms into helium than the spectroscope.

Our common experience of the large effect of temperature in ordinary chemical reactions tends to make us take a rather exaggerated view of the probable effects of high temperatures on the stability of atoms. While it seems quite probable that momentary temperatures of 50,000° F. can be obtained under suitable conditions in condenser discharges, it should be borne in mind that the average energy of the electrons in temperature equilibrium with the atoms at this temperature corresponds to a fall of potential of only 6 volts. In many physical experiments we habitually employ streams of electrons of much higher energy and yet no certain trace of disintegration has been noted. In particular, in Coolidge tubes an intense stream of electrons of energy about 100,000 volts is

[1] The Dawn of the Cell Theory, *Scientific Monthly*, Vol. XIV, No. 3, pp. 268-277, March, 1922.

[1] Sir Ernest Rutherford, in *Nature*.

constantly employed to bombard a tungsten target for long intervals, but no evolution of helium has so far been observed.

A RESEARCH FELLOWSHIP IN BACTERIOLOGY

THE Society of American Bacteriologists at its recent meeting in Philadelphia, appropriated a fund for the support of a research fellowship in pure bacteriology. While excellent work is being carried on in many places, nearly all the problems under investigation have as their aim a practical application and there are, therefore, many gaps in our knowledge of fundamental principles. The society, believing it to be the duty of bacteriologists to fill these *lacunæ*, requires that the line of work to be carried on under its fund must concern a purely scientific and fundamental phase of bacteriology, although a certain latitude of choice will be permitted, conditioned by the previous training and the desires of the research fellow himself.

Applicants for the fellowship must have the degree of B.S. or its equivalent. The successful candidate, through arrangements now being made, will receive academic credit for the work done from a university of recognized standing. One hundred dollars a month will be available for the living expenses of the fellow. Approximately half his time will be devoted to details connected with the society's collection of bacteria, deposited at the Army Medical Museum.

The selection of the research fellow will be in charge of a committee consisting of:

Dr. Victor C. Vaughan, chairman of the Medical Section, National Research Council, *Chairman.*

Captain C. S. Butler, Medical Corps, U. S. Navy, commandant, Naval Medical School.

Dr. Geo. W. McCoy, director of the Hygienic Laboratory, U. S. Public Health Service.

Dr. John R. Mohler, chief, Bureau of Animal Industry.

Mr. L. A. Rogers (president of the Society of American Bacteriologists), in charge of research laboratory, Dairy Division, Bureau of Animal Industry.

Colonel Joseph F. Siler, Medical Corps, U. S. Army, Division of Sanitation, Office of the Surgeon General of the Army.

Dr. Erwin F. Smith, pathologist in charge, Laboratory of Plant Pathology, Bureau of Plant Pathology.

This committee will have general supervision of the work, approve the problem selected and pass upon the thesis which the fellow will submit as the report of his research. Applications for and communications concerning the research fellowship should be addressed to the chairman of the committee, Dr. Victor C. Vaughan, National Research Council, Washington, D. C.

A. PARKER HITCHENS,
Secretary of the Committee
ARMY MEDICAL SCHOOL,
WASHINGTON, D. C.

THE CULTURE COLLECTION OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS

THE Society of American Bacteriologists has taken over the collection of cultures which for the past ten years has been maintained at the American Museum of Natural History by Professor C.-E. A. Winslow, and has deposited it at the Army Medical Museum, where facilities have been arranged for its housing and maintenance.

The following committee will be in charge:

Dr. J. M. Sherman, Dairy Division, Bureau of Animal Industry, *Chairman.*

Major G. R. Callender, curator of the Army Medical Museum.

Dr. Geo. W. McCoy, director of the Hygienic Laboratory, U. S. Public Health Service.

Major H. J. Nichols, Army Medical School.

The president of the society.

The secretary of the society.

These and other members of the society in and near Washington will do volunteer work and the research fellow will do part time work in maintaining the collection. No charge will be made for cultures. In making requests, the classification of the society should be followed as far as possible. Mail should be addressed to the Department of Bacteriology, Army Medical Museum, 7th and B Streets, S. W., Washington, D. C.

J. M. SHERMAN
Chairman of the Committee

STATION FOR THE STUDY OF DECIDUOUS FRUITS AT STANFORD UNIVERSITY

THE United States Government has established an experiment station on the Stanford campus in cooperation with the university for scientific work on the breeding and improve-

ment of deciduous fruits. The university has furnished 20 acres of land together with irrigation water free of charge, and on this plot the Bureau of Plant Industry of the Department of Agriculture, under the direction of W. F. Wight, is planting trees designed to be a basis of extensive experiments in the breeding, selection and domestication of various fruits for the purpose of developing varieties having greater disease resistance and better adapted for cultivation than those now grown.

Mr. Wight is in charge of the horticultural and pomological investigations of the Chico Experiment Station and cooperating with him as representative of the university is Professor Leroy Abrams of the department of botany of the university.

The Stanford campus was selected for an experiment station because the Santa Clara Valley supports a greater variety of deciduous fruits than any other place in the country, and also because Stanford will be the headquarters for the work in fruit classification studies for this part of the country, and perhaps ultimately for the Pacific Coast. The library facilities, as well as collections of the fruits to be studied, are necessary for the work.

The work carried on at Stanford will be of local value to the Santa Clara Valley on account of the attention that will be paid to the apricot and prune, but will be of wider scope. It is planned to make a study of the varieties of pears of high quality and resistance to pear blight. It is hoped that the work will be of value wherever deciduous fruits are grown in this country.

It is planned to carry on experiments through a period of at least ten years with the probability that they will be continued indefinitely. By the agreement between the government and the university, all plant material in the experiment station will be available to the department of botany of the university for study and investigation, provided such work does not interfere with the government's undertaking. The distribution of the material will probably be through state experiment stations, nurseries and to individual growers where the latter are in a position to grow a given variety on a commercial basis.

THE AMERICAN PHYSICAL SOCIETY

THE one hundred and fifteenth regular meeting of the American Physical Society will be held in Washington, at the Bureau of Standards, on Friday and Saturday, April 21 and 22, 1922. The first session will begin at 10 o'clock on Friday morning.

The Association of Scientific Apparatus Makers will hold meetings at the Bureau of Standards on the same days as will the American Physical Society. Arrangements have been made for a joint informal dinner on the evening of Friday, April 21. It is expected that addresses will be made by Dr. S. W. Stratton in behalf of the Bureau of Standards, by Professor F. K. Richtmyer, representing the Association of Apparatus Manufacturers, and by Professor R. A. Millikan, representing the American Physical Society. Arrangements are being made for an exhibit of scientific apparatus at the Bureau of Standards.

The other meetings for the calendar year will be as follows: The Thanksgiving meeting, on November 25, 1922, will be held at the University of Chicago. The annual meeting, beginning on December 26, will be held in Boston, in affiliation with the American Association for the Advancement of Science.

The Pacific Coast Section will hold a meeting at Salt Lake City, at the time of the meeting of the Pacific Division, A. A. A. S., on June 22, 23 and 24, 1922. Correspondence relating to this meeting should be addressed to the secretary of the Pacific Coast Section, Professor E. P. Lewis, University of California, Berkeley, California.

DAYTON C. MILLER,
Secretary

SCIENTIFIC NOTES AND NEWS

A CELEBRATION was held at Bryn Mawr College on April 11, in honor of Professor Charlotte Angus Scott, who has been head of the department of mathematics since the college opened in 1885. Professor Albert N. Whitehead, of the University of London, came to America to make the principal address. Among those who planned to be present were: Professors George David Birkoff, Harvard; Ernest William Brown, Yale; Emilie Norton Martin,

Mt. Holyoke; Helen Abbot Merrill, Wellesley; Roland George Dwight Richardson, Brown; Oswald Veblen, Princeton; Henry Seely White, Vassar, and Ruth Goulding Wood, Smith.

A TESTIMONIAL dinner in honor of Dr. George E. de Schweinitz, president-elect of the American Medical Association, was held in Philadelphia, on April 4, under the auspices of the Philadelphia County Medical Society. Dr. Hobart A. Hare was toastmaster, and the speakers were: Dr. Hubert Work, president of the association and postmaster general of the United States; Dr. William C. Braisted, president of the Philadelphia College of Pharmacy; Dr. Ross V. Patterson, dean of the Jefferson Medical College, and Dr. John G. Clark, professor of gynecology in the Medical School of the University of Pennsylvania.

PRESIDENT PORRAS, of Panama, on April 7, tendered a reception to Dr. Richard P. Strong, professor of tropical medicine at Harvard University and director of the Gorgas Memorial Institute, recently founded there. Dr. Strong started on the following day on a tour of the interior.

THE Royal Geographical Society will award its medals and grants as follows: *The Founder's Medal* to Lieutenant Colonel C. K. Howard-Bury for his distinguished services in command of the Mount Everest Expedition of 1921; *The Patron's Medal* to Mr. Ernest de K. Leffingwell for his surveys and investigations on the coast of northern Alaska; *The Victoria Medal* to Mr. J. F. Baddeley for his work on the Historical Geography of Central Asia; *The Murchison Grant* to Mr. Charles Camsell for his explorations and surveys in northern Canada; *The Back Grant* to Khan Bahadur Sher Jang for his surveys on the Indian frontier; *The Cuthbert Peek Grant* to Mr. F. H. Melland for his explorations in northern Rhodesia; and *The Gill Memorial* to Mr. A. A. R. Boyce for his triangulations in the Sudan.

WE learn from *Nature* that the following were elected fellows of the Royal Society of Edinburgh at the meeting on March 6: Mr. C. L. Abernethy, Professor G. Barger, Sir Dugald Clerk, Dr. F. A. E. Crew, Dr. W. O. Greenwood, Mr. W. A. Guthrie, Professor R. K. Hannay, Professor E. Hindle, Dr. C. F. Juritz, Professor J. C. Meakins, Mr. M. Macgregor, Dr. Bijali Behari Sarkar, Professor H. W. Turnbull, Dr. J. Walker, Mr. J. Wilson, Mr. J. M. Wordie.

DR. O. STAPF, who has been keeper of the herbarium and library at the Royal Botanic Gardens, Kew, since 1908, has retired on reaching the age limit. He is succeeded as keeper by Mr. A. D. Cotton, formerly a member of the herbarium staff and lately mycologist to the Ministry of Agriculture and Fisheries.

The *Engineering and Mining Journal* and *Mining and Scientific Press* were consolidated on April 1, to form the *Engineering and Mining Journal-Press,* with Josiah Edward Spurr as editor.

A NEW major subdivision has been created in the United States Geological Survey by raising the division of Alaskan mineral resources to the status of a branch. The work will continue under the immediate direction of Colonel A. H. Brooks, whose title under the rearrangement is chief Alaskan geologist.

R. T. STULL, who for several years has been superintendent of the Columbus (Ohio) Experiment Station of the Bureau of Mines, has been appointed assistant chief of the bureau's mineral technology division. In that position he will have technical supervision over the work in non-metallics and in ceramics.

DURING the absence of Director Frank Schlesinger, who is attending the meeting of the International Astronomical Union in Rome and will be absent until the latter part of May, Professor Ernest W. Brown is to serve as acting director of the Yale Observatory. Mr. Carl L. Stearns, assistant at the observatory, with the rank of instructor, has been granted leave of absence for a year beginning July 1, 1922.

FOLLOWING the return of Dr. H. H. Rusby, the scientific men who were members of the Mulford Expedition to South America, arrived in New York last week. They include Dr. W. M. Mann, assistant entomologist of the U. S. Department of Agriculture; Dr. Orlando E. White, assistant botanist of the Brooklyn

Botanical Garden, and Dr. Everett Pearson, of the University of Indiana.

On April 4, Professor W. H. Hobbs, of the University of Michigan, completed his lectures at the Technical High School of Delft in exchange with Professor Brouwer. On May 4, he will sail for the Windward Islands and the west coast of South America, returning to Ann Arbor on September 1.

The National Research Council has appointed a committee to investigate the properties of ammonium nitrate. The personnel of the committee is as follows: C. E. Munroe, National Research Council, *Chairman;* S. P. Howell, representing the Bureau of Mines; R. C. Tolman, representing the Department of Agriculture; C. G. Storm, representing the Ordnance Department, United States Army; C. P. Beistle, representing the Bureau of Explosives of the American Railway Association; and C. A. Bigelow, representing the Institute of Makers of Explosives. It is expected that the Navy Department will also be represented on this committee.

The spring meeting of the American Electrochemical Society will be held in Baltimore, beginning on April 27. The morning will be devoted to a symposium on electric cast iron in charge of A. P. Hinckley and Bradley Stoughton. In the evening Professor R. W. Wood, of Johns Hopkins University, will speak on the subject of fluorescence. Acheson Smith, the retiring president, will deliver the presidential address.

Dr. Hendrik Anton Lorentz, of the University of Leiden, has given, in the Jefferson Physical Laboratory at Harvard University, three lectures on mathematical physics. It will be remembered that Dr. Lorentz has been lecturing at the California Institute of Technology, Pasadena, whose invitation to deliver a special series of lectures was the occasion of his present visit to the United States. Before returning to the Netherlands on or about the first of May, he is visiting a number of American universities.

Dr. E. W. Washburn, of the department of ceramics of the University of Illinois, lectured on April 6 before the Franklin Institute on "Physical chemistry and ceramics." On April 13 a lecture on "The physics of the three-electrode bulb" was given by Professor K. T. Compton, of Princeton University. On April 19, Professor William D. Harkins lectured before the institute on "The structure and building of atom nuclei."

Professor Charles R. Stockard, of the department of anatomy, Cornell University Medical College, delivered a lecture on heredity at the meeting of the Philadelphia Pediatric Society, on March 14.

Professor J. Paul Goode, of the University of Chicago, gave an address at the annual meeting of the Cleveland Chamber of Commerce on March 21 on the subject, "American opportunity in world trade." On March 22 he spoke at Georgetown University, Washington, on "America as a world power," and on March 24 he lectured on "Industrial Japan" for the National Geographic Society at Washington.

Dr. Charles W. Eliot, president emeritus of Harvard University, spoke on "Prevention of disease through animal experimentation," at a public health conference in Boston, on March 29, under the auspices of the Massachusetts State Federation of Women's Clubs.

The Bakerian lecture of the Royal Society will be delivered on March 9 by Professor T. R. Merton and Mr. S. Barratt on "The spectrum of hydrogen."

Dr. Harris Graham, for thirty years professor of pathology and practice of medicine in the American University of Beirut, died in his sixtieth year on February 27, at Beirut, Syria.

Sir Patrick Manson, distinguished for his work on malaria and tropical diseases, died on April 8 at the age of seventy-six years.

Dr. J. T. Merz, author of *The History of European Thought in the Nineteenth Century,* died on March 21 at the age of eighty-two years.

The death, on March 24, at fifty-eight years of age, is announced of Professor W. B. Bottomley, professor of botany at King's College, London, from 1893 to 1921.

THE John Macoun Memorial Committee of the Ottawa Field Naturalist's Club announces that, as the number of copies to be issued of the autobiography of the late Professor John Macoun, naturalist to the Geological Survey of Canada, is limited, orders, with or without the subscription price of $3, should be sent in by May 15, addressed to Mr. Arthur Gibson, treasurer, John Macoun Memorial Committee, Birks Building, Ottawa, Canada.

DR. GEZA HORVATH, director of the section of Zoology of the Hungarian National Museum in Budapest, writes that the price of the complete series of the *Annales historico-naturales Musei Nationalis Hungarici* (Volumes I to XVIII) has been reduced from $108 to $58. It is the hope of the administration of the museum that, through the sale of sets of these important *Annals*, they will be able to add to the funds needed to pay the present exorbitant charges for the publication of current and future volumes.

THE Royal Academy of Belgium announces that a triennial prize of 2,500 francs, to be known as the Prix Joseph Schepkens, for the best experimental work on plant genetics, has been established.

THE German Congress of Surgery will be held at Berlin, under the presidency of Professor Hildebrand, from April 19 to April 22, when the following subjects will be discussed: The experimental principles of wound injection, introduced by Professor Neufeld, of Berlin; general surgical infection, introduced by Professor Lesser, of Freiburg; operative transplantation of muscles, introduced by Professor Wullstein, of Essen, and the importance of histological examination of the blood, introduced by Professor Stahl, of Berlin.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of Missouri, Columbia, Mo., will erect a new chemistry building to cost $125,000.

MISS KATE C. GARRICK, daughter of the late Sir James Francis Garrick, for ten years agent-general in London for Queensland, has by her will bequeathed £10,000 to the University of Queensland to found a James Francis Garrick professorship of either law or medicine, as may seem best to the university, in memory of her father.

DR. EDWIN B. WILSON, professor of mathematical physics in charge of the department of physics at the Massachusetts Institute of Technology and a member of the administrative committee of the institute, has been appointed professor of vital statistics at Harvard University. He has also been appointed a member of the administrative board of the School of Public Health, the other members being David L. Edsall, chairman, Milton J. Rosenau, Roger I. Lee and Cecil K. Drinker.

THE following promotions to associate professorships have been made at Yale University: Dr. Francis Kovarik and Horace Scudder Uhler, in physics; Herbert L. Seward, in mechanical engineering; Charles S. Farnham, in civil engineering, and Richard S. Kirby, in engineering drawing. Dr. Arthur J. Hill has been promoted to an associate professorship in organic chemistry, with assignment to the Sheffield Scientific School and the Graduate School. William L. Crum, Ph.D., has been advanced to an assistant professorship in mathematics. English Bagby, Ph.D., in psychology, and Archer E. Knowlton, E.E., in electrical engineering, have been advanced to assistant professorships.

DISCUSSION AND CORRESPONDENCE

DEVONIAN PLANTS

To the geologist, the invertebrate paleontologist, or the stratigrapher who turns to the map of North America, the Devonian system is one of a completeness and grandeur that must be satisfying in the extreme. The mapping has proceeded through nearly a century, and the horizons have been divided on accurate faunal data. To long lists of invertebrates are added remarkable fishes.

To the paleobotanist on the contrary, the Devonian is at once alluring and forbidding. While the algæ with a great record go back to

the Precambrian, the recognizable land floras begin in the Devonian. But the great expanses of Devonian rock are for the main part beyond the reach, knowledge, and experience of the paleobotanist. Away to the Canadian Northwest and extending far into Alaska, the main Devonian mass stretches for 2,000 miles through the remotest region of the continent. Thence scarcely a plant has come. Far or near, no one goes into the Devonian field for plants, and the "finds" are apt to be neglected year after year. Although the world's first great forests appear in the Devonian, from all North America not 200 species of Devonian plants could be named, and those mostly of little satisfactory definition.

Inasmuch as Devonian plant materials must long fail to bulk up as a workable assemblage without some initial and better coordinated attention, I wish the invertebrate paleontologists and geologists who have data would supply them to me or to others interested, in the form of brief memoranda, or promptly publish the same. It should shortly be possible to see Devonian paleobotany on a better basis. Meanwhile it would be especially gratifying if some attention could be given to the following inquiries:

(1) Which are the main shale or other sections where Devonian plants have been seen?

(2) Are there good Psilophyton localities,—(*a*) where stems are petrified, (*b*) well carbonized?

(3) What North American localities of the lower Devonian yield silicified stems large or small? The British geologists cite the Cordaite, Paleopitys milleri of the old Red.

(4) Are there any North American Devonian cherts containing stems comparable to *Rhynia*, the most primitive of vascular plants, as occurring in the siliceous cherts of Aberdeenshire, Scotland?

(5) Are there any well marked seeds in the Indiana Black shale, the Genesee shale, the Waverleyan? Are there any typical pteridospermous, or gymnospermous seeds in the North American Devonian at all?

The enormous extent of parallelism in the lines of plant descent, and the exceedingly small percentage of known forms in pre-Carboniferous rocks, give to every discovery of plants in the Devonian a high value. It is to-day patent that better plant phylogenies much depend on the closest attention to chronology, and especially on new discoveries in the Devonian.

I should state that it is not my purpose to take up the subject of Devonian plants but to help others to do so, as I am persuaded that much material of value is being lost, or too long unnoted. Is it not grievous to admit that in the past twenty-five years, contributions to Devonian paleobotany have been so lacking from North America? There is for the Waverleyan at the close of Devonian time the very fine contribution of Scott and Jeffrey. And from the Indiana Black shale there is the fine Cordaite *Callixylon Oweni* of Elkins and Wieland. There the record of publication about closes.

But what possibilities of discovery there must be in the rocks that yield such a striking forest type as the "Naples tree," *Protolepidodendron*, interestingly restored at the State Hall at Albany! The great dearth of knowledge of the Devonian plant front is due to the failure to get the evidence in the field; although it is admitted that here discoveries and collection are difficult. It is possible to search given Devonian horizons for invertebrate material with success, because occurrences have been sought out and diligently described, the continent over, for the past three or four score years. The impression thus grows upon us that with attention in kind, the Devonian plant record for the continent would soon be augmented, and that relative importance of scientific subjects asks such a result. Is the investigation of the Devonian to be carried on only in other countries? Can we make no such brilliant discoveries as those from the Devonian cherts of Aberdeenshire?

G. R. WIELAND

YALE UNIVERSITY

THE EFFECT OF ALKALI ON THE DIGESTIBILITY OF CELLULOSIC MATERIALS

THE communication of Professor Lindsey on the above subject in your issue of February 3 is of considerable interest to students of cellulose chemistry inasmuch as it indicates the

possibility of converting waste material into valuable food products.

In view of the interesting results obtained in Germany during the recent war, on the action of alkalis on chopped straw, this matter is well worthy of a thorough study. In a recent lecture by the writer to the Syracuse Section of the American Chemical Society on "The rôle of alkali in the future development of the cattle food, cellulose, paper-pulp and liquid fuel industries," attention was drawn to the fact that experiments carried out at the behest of the German War Office show that by the simple process of boiling chopped straw for three hours with a one per cent. solution of sodium carbonate a 75 per cent. yield of material is obtained, of which 75 per cent. is digestible, and this in spite of the relatively high lignin content. A full account of this work is to be found in the recent pamphlet by Hans Magnus entitled, "Theorie und Praxis der Strohaufschliessung," published by Paul Parey, Berlin, 1919. Further information and additional references are to be found in the recent work of Hans Pringsheim, "Die Polysaccharide," Berlin, 1919.

It would seem that the treatment with soda ash is peculiarly applicable to American conditions and offers to the individual farmer the possibility of obtaining a cheap cattle food from such waste materials as chopped straw, ground corn cobs, etc., by the use of a chemical product with which he is familiar and employing only the simplest type of machinery. The resulting material when mixed with molasses apparently yields a profitable and palatable cattle food of high nutritive value.

Lantern slides have been made of the various tables quoted in the pamphlet by Magnus, and the writer will be pleased to loan them to any one interested in lecturing on this subject.

HAROLD HIBBERT

YALE UNIVERSITY

BUTYL ALCOHOL AS A REAGENT IN HISTOLOGY

PROFESSOR GRIFFIN'S article in SCIENCE for March 10, recommending the use of isopropyl and methyl alcohols for histological work, impels the writer to call attention to the practicability of using butyl alcohol, as recently suggested by Larbaud,[1] for similar purposes. Among the advantages claimed for this reagent are that it obviates difficulties due to the presence of slight amounts of water in so-called "absolute" ethyl alcohol, and that it does away with the contraction and hardening due to xylol, since butyl alcohol is a solvent of paraffin and therefore takes the place of xylol or chloroform as well as of the higher alcohols. As butyl alcohol does not mix readily with water, Larbaud recommends a mixture of equal parts of butyl and 95 per cent. ethyl alcohols in appropriate dilutions for the lower grades in the dehydrating series. There seems to be no *a priori* reason why a mixture of butyl and methyl alcohols would not serve equally well. The writer has used Larbaud's methods, with slight modifications, for the dehydration and infiltration of fungus tissues for cytological study, with entirely satisfactory results.

GEORGE W. MARTIN

HULL BOTANICAL LABORATORY,
UNIVERSITY OF CHICAGO

GENETICS OF THE VIENNA WHITE RABBIT II.

IN SCIENCE for March 10, I described the genetics of a variety of white rabbit having colored eyes, which I supposed to be identical with the variety known in Europe as Vienna White. This variety I had synthesized by crossing albinos carrying the gene for yellow coat, with chinchillas, and I showed the white variety with colored eyes to be genetically a "yellow chinchilla." Since writing that article I have been able to obtain from Europe a pair of Vienna White rabbits and I find that, though they look like my synthetic white rabbits, they breed very differently. When crossed with yellow rabbits, they produce not *yellow* young, as my synthetic whites should do, but blue, black or gray young, according to the genetic constitution of the yellow parent, and these young are invariably *Dutch-marked*, pre-

[1] Larbaud, Mlle.: Nouvelle technique pour les inclusions et les préparations microscopiques des tissues végétaux et animaux. *Comptes. Rend. Ac. Aci. Paris*, 172: 1317-1319. 1921.

cisely as in the experiment of Baur. This result shows that the Vienna White rabbit is in reality a Dutch rabbit, with a completely white coat, as suggested by Punnett. Its eyes are blue as in blue rabbits regularly, but the choroid is white as in the whitest Dutch rabbits. The white rabbit which I have synthesized is a new type of white rabbit, entirely distinct from Vienna White.

W. E. CASTLE

BUSSEY INSTITUTION,
MARCH 28, 1922

UNIVERSITY PROFESSORS AND MAJOR-GENERALS IN POLAND

A RECENT statement by the official Polish Bureau of Information in New York indicates the existence of an interesting condition in Poland regarding the status of university professors in that so-called backward country. The following is the statement, *verbatim:*

University professors in Poland have equal ranking with major generals, and, being state officials, are accorded all the rights and privileges enjoyed by major generals. According to a recent announcement, there are at present 638 full professors in the Polish universities and higher academic schools. The salaries of professors are somewhat higher than that of the undersecretary of state.

VERNON KELLOGG

WASHINGTON, D. C.

QUOTATIONS

"THE SCIENTIFIC SIDE"

"Mme. Bisson assisted Mlle. Eva in a cabinet in which I was present with other observers," he said. "Mlle. Eva was wrapped in a heavy rubber coat in order to protect her body from the light as much as possible. She entered into a trance and after a short time an aperture was opened in the front of the rubber coat so that I could look within. I saw the ectoplasm in a thick slimy band encircling her body like some monstrous worm.

"'May I touch it?' I asked Mme. Bisson.

"She replied, 'Yes.'

"I reached within the aperture and firmly grasped between thumb and forefinger the belt-like mass, and as I held it I felt it writhe—a living, pulsing substance."

Sir Arthur stated his belief that the medium would have died from shock had any attempt been made to remove this reputed ectoplasm, but the observers finally managed to pinch off a small portion, and this was hurried into a laboratory where Professor Richet of the University of Paris made a microscopic and chemical examination.

"It was found to consist of mucoid cells, epithelial cells, a clear, slimy fluid, certain carbonates, and other compounds. It was a sort of etherealized matter, if such a term may be employed.

He cited the circumstances of a number of seances, and in one case read testimonies of other observers who were present.

"In one instance Mrs. Wriedt of Detroit, an American medium of great power, came to my house and we held a séance in the nursery, a room certainly devoid of suspicious surroundings. My wife and I, Mrs. Wriedt, and my secretary, Major Wood, held hands as we sat around a table, and having learned the value of singing in such experiments we all sang softly in chorus. We knew the words of the hymn, 'Onward, Christian Soldiers,' and by common consent took up this air. Suddenly there burst out overhead a clear joyous baritone voice, singing with us word for word. I stopped and heard the voices of my wife, of Mrs. Wriedt, and of Major Wood. And above them all was this ringing baritone voice.

"If that isn't a spiritual phenomenon, what is it?" he cried. "I have a right to ask that question."

He narrated details of numerous other séances, of one in which he declared he saw the face of his dead mother, "as plain as a Rembrandt portrait emerging from the dark," every wrinkle and line as he had seen her last.

"Again," he said, "I went to Southsea, where a Welsh miner was staying. This was the medium, Evan Powell.

"In this séance there were four other observers besides myself. Powell sat in my room

[1] Concluding part of a lecture with this title given by Sir Arthur Conan Doyle in Carnegie Hall, New York City, on April 12, as reported in the *Evening Post*.

in a chair and asked me to tie him in place. So well did I tie him that we had to cut him out afterwards. Then he fell into a trance, and suddenly I became aware of dazzling celestial lights over his head. Then my son's voice cried out: 'Father, father.' The voice was not a yard from my face.

"Yes, my boy," I answered. "Yes, what is it?"

"'Father! Pardon!' he said, and I felt his hand on the top of my head, bowing down my head, and then felt his lips touch my forehead.

"I knew what he meant immediately. Only I could have known. He had never subscribed to my belief while alive, and now he had come back to tell me that it had been as I said.

"'Yes, my son,' I called back to him, 'you had a right to your own belief while here with us.'"

Again the speaker, wrought up to a high pitch, cried:

"If that isn't spiritual communication, what is it?" And the audience, listening intently to every word, broke out in a clatter of applause.

SCIENTIFIC BOOKS

Studies of the Development and Larval Forms of Echinoderms. By TH. MORTENSEN. 266 pages, 33 plates and 102 text-figures. Published at the expense of the Carlsberg Fund. G. E. C. Gad, Copenhagen, 1921.

For some years, the well-known Danish zoologist, Dr. Th. Mortensen, has been gathering material in the embryological field to use in throwing light on the phylogeny of the echinoderms and on the interrelationships of families and genera in the most perplexing groups. A two year's journey around the world including stays of several weeks or more at Zamboanga and Jolo in the Philippines; Misaki, Japan; Sydney, N. S. W.; New Zealand; Hawaii; Nanaimo, British Columbia; La Jolla, California; Taboga Island, Panama; and Tobago, B. W. I., resulted in such an accumulation of material that the present noteworthy report has been prepared and published. Yet the indefatigable Danish investigator is again afield in search of more material and at the same time is hunting out the best place in the East Indies for the establishment of a permanent Scandinavian marine biological station!

As one turns the pages and studies the plates of this great contribution to embryology, it is hard to decide whether one should admire the more the industry, patience and skill of the investigator, or the ability to marshal his facts and set forth clearly his conclusions, revealed in the writing. Descriptions and figures alike leave nothing to be desired and even if one were not to accept all the suggested conclusions one can not question the care or the fairness with which they are expressed.

An introduction of 19 pages gives a brief but clear summary of what has so far been accomplished in acquiring knowledge of the embryology of those echinoderms which have free-living larval forms. Including Mortensen's own results we now have such knowledge, often very fragmentary it must be granted, of some 125 species. There is also much material accumulated concerning the life histories of many species which do not have free-living larvæ, but these are not included within the scope of the present report. The main purpose of Mortensen's research has been, to quote his own words, to throw light on "the interrelation between the larvæ and the adults in regard to a natural classification."

The second section of the report, designated "Special Part," deals with the larvæ of more than sixty identified species and nearly fifty additional larvæ, whose parent forms are unknown. No crinoids are discussed, as Dr. Mortensen has published his studies on crinoid development elsewhere. As experience demonstrated that the eggs of echini are more easily fertilized artificially than are those of other echinoderms, it is not surprising that nearly three fourths of Mortensen's work was done on members of that class, at least so far as results reveal. The early stages of no fewer than 43 species were studied and many species were carried along through weeks and sometimes months of larval life. One of the interesting results of this work was the demonstration of the hardiness of the larvæ of certain species. Thus some larvæ of the common West Indian rock-boring urchin (*Echinometra lucunter*), hatched from eggs fertilized

the last week in March or early in April, were carried from Tobago to Copenhagen via New York, arriving in Denmark, June 1, still living, though not thriving! Besides the larvæ whose parentage was certain, Mortensen describes and discusses the relationships of nine echinoid larval forms taken in tow nets.

Among the sea-stars, artificial fertilization was successful with eleven species, and the larvæ resulting are described in ten of them, to a greater or less extent. Owing to unsatisfactory preservation no asteroid larvæ from tow-net collections are described. With the holothurians and ophiurans, particularly the latter, artificial fertilization is exceedingly difficult to obtain and with only two species of brittle-star (both at Tobago) was Mortensen able to study material derived from eggs fertilized in the laboratory. With holothurians, artificial fertilization was successful in three species, but with two of these the larvæ only lived two or three days. On the other hand, Mortensen describes three forms of a noteworthy Auricularia, one from Tobago, one from Misaki, and the third from New Zealand waters, and no fewer than 35 ophiuran larvæ, whose parentage is unknown. The most extraordinary fact recorded in this section is that certain Ophioplutei do not end their free-swimming existence by complete metamorphosis into miniature brittle-stars, but rather give off the new ophiuran as a sort of bud, and then apparently *regenerate a new larval body in place of the original one.* If this new body is capable of giving rise to a new ophiuran by a second metamorphosis, we have here, as Mortensen says, the only case of metagenesis known in the whole Echinoderm phylum. But the evidence is tantalizingly incomplete.

The last fourth of the volume, entitled "General Part," is divided into three sections, a short one on "Classification," a longer called "Morphology, Phylogeny, Biology," and a few pages on "Geographical Distribution." In the first section, Mortensen raises the question whether there is any correspondence between groups of larvæ arranged according to structure and the natural groups of the adults, and so far as the major groups of echini are concerned, he answers the question in the affirmative with little hesitation. He has further unquestionably demonstrated that no classification of echini can henceforth be accepted which does not give fair consideration to the characters of the larvæ so far as they are known. As for the ophiurans on the other hand, we are on much less sure ground, nor can we make very practical use of the ophioplutei in classification until a far larger number of them have been traced back to their parent forms. Among the Asteroidea, too, we still lack sufficient data, in spite of Mortensen's masterly efforts, but enough facts are known to warrant the hope that the various larval forms will prove of great value in tracing relationships within the class. The Crinoidea and Holothurioidea are still largely *terra incognita,* so far as larval forms are concerned. In the pages dealing with the morphology of the larvæ, a number of debatable points are discussed and one very important one is emphasized, namely, that there is no homology between the sucking-disk of a brachiolarian larva and the Pelmatozoan stalk. The remarkable animal described by Koehler and Vaney as *Stellosphæra mirabilis* is shown to be a larval form of a sea-star, probably *Pedicellaster sexradiatus.* After a detailed discussion of the various larval forms, Mortensen pays his respects to Grave's theory that the primitive echinoderm larval form had transverse rings of cilia, and then passes on to an interesting discussion of the proposals of Boas, Simroth and A. H. Clark regarding the phylogeny of the echinoderms, though the ideas of the last two are dismissed briefly, their refutation being designated "a superfluous task"! There then follow discussions of Giard's theory of *poicilogony,* as applied to echinoderms, of the rate of growth of larvæ, and of the relation of temperature to the production of matured reproductive cells. The pages devoted to geographical distribution deal mainly with the matter of the influence of currents in the distribution of echinoderm larvæ and the probable existence of vertical upward currents, which are important in bringing the larvæ of deep sea forms to the surface.

The volume closes with a brief appendix and a very full explanation of the admirable plates. There is no bibliography and no index,

but the absence of the latter is atoned for by the presence of a table of contents just before the introduction. As in most of Dr. Mortensen's publications the illustrations are all that could be desired and are of the greatest service to the user of the book, while the text is entirely free from ambiguities and shows the customary positiveness of the writer. The whole appearance of text and plates is admirable and the Carlsberg Fund, no less than the author, is to be congratulated on this very important contribution to our knowledge of echinoderms.

HUBERT LYMAN CLARK

SPECIAL ARTICLES

A BACTERIAL WILT OF THE BEAN CAUSED BY BACTERIUM FLACCUMFACIENS NOV. SP.

A NEW bacterial disease of navy beans has appeared in South Dakota. The grower on whose farm the disease was discovered reports that what he believes to be the same disease killed 90 per cent. of his 1920 crop. In 1921 he planted the seed harvested from the remainder and lost about 25 per cent. of his crop. Some of this 1920 Dakota seed planted at Arlington, Virginia, also produced a large proportion of diseased plants, many of which never survived the seedling stage. The disease is characterized by a wilting of the leaves of seedlings sometimes accompanied by a discoloration, and by dwarfing, reduction of yield and the death of some of the shoots, if the plant survives the early stages of growth.

Plants from South Dakota, received in the Laboratory of Plant Pathology, Bureau of Plant Industry, August 6, 1921, were found to contain bacteria in the vessels of the stem often accompanied by a browning of the vascular ring. The writer suspected the presence of *Bacterium solanacearum* Erw. Sm. but when petri dish poured-plates were made from the diseased stems a yellow organism was isolated. This, when pricked into vigorously growing King of the Mountain bean seedlings produced the wilt in every case. From these infected plants the yellow organism has been reisolated and has produced the wilt in Great Northern beans. King of the Garden lima and Ito San soy-beans have also become infected as the result of pure culture inoculations.

The same organism has been isolated from the Arlington, Virginia, plants and with it the writer has reproduced the disease.

The discoloration mentioned above may consist of a dull green or brownish green, greenish brown or reddish brown area sometimes bordered with yellow. The discolored area is flabby at first and later dry and papery. In many cases the whole leaf blade and petiole become flabby and droop without any discoloration at all, whereas in others a portion of the leaf becomes flabby and discolored while the rest of the blade and the petiole is turgid for a time at least. It is presumably a question of the number of vessels plugged by the bacteria. This same phenomenon has occasionally been observed in secondary infections of young leaves by *Bacterium phaseoli*.

The wilt of the seedlings in some respects suggests the "systemic disease" of beans ascribed by Burkholder to *Bacterium phaseoli* but the parasite under consideration is very different from *Bacterium phaseoli*. For example, its very moderate, often scanty growth on potato cylinders, due to its very slight diastasic action, is in marked contrast to the exceedingly copious prolonged growth and marked diastasic action of *Bacterium phaseoli* Erw. Sm. The color on potato is Ridgway's mustard or primuline yellow (Color Standards and Nomenclature, plate XVI, 2nd ed., 1912) and there is usually a marked graying of the potato. The difference in the colonies are less marked but plates of the two organisms when compared are easily distinguishable. The colonies of *Bacterium phaseoli* are much more wet-shining and of a much more syrupy consistency. Both *Bacterium phaseoli* and the South Dakota organism reduce the litmus in litmus milk in 4 to 7 days but the cultures of the latter finally become acid and the behavior of the two organisms is very different in regard to the manner and time of the other changes taking place in the milk. Cultures of *Bacterium phaseoli* begin to clear in 1 to 6 days, and a very soft mobile curd is formed, a partial peptonization

of the casein preventing the formation of a solid coagulum. In cultures of the South Dakota organism, on the other hand, there is usually no visible change in plain milk for about three weeks, after which, in varying lengths of time, the fluid becomes solid. Some days after coagulation there is an extrusion of whey and finally peptonization begins, progressing very slowly however. *Bacterium phaseoli* produces tyrosin crystals in abundance in milk but none have been observed in cultures of the South Dakota organism. The latter produces a wide, deep yellow rim (Ridgway's primuline yellow loc. cit.) which is very striking.

Both organisms liquefy gelatin but *Bacterium phaseoli* does it rapidly whereas the South Dakota organism does it so slowly that for the first month there is little or no liquid gelatin present, evaporation taking place almost as rapidly as the liquefaction.

Another good medium for differentiating these two organisms is Congo Red agar. Both organisms take up the stain to a greater or less degree and finally change the agar to a purplish color but *Bacterium phaseoli* makes a very thick, smooth, wet-shining growth and the South Dakota organism only a very meager one. This medium is prepared as follows: 1000.00 c. c. distilled water; 10.00 g. saccharose; 1.00 g. dipotassium phosphate; 0.20 g. magnesium sulphate; 15.00 g. agar flour; 0.10 g. Congo red (Grübler's). Steam the water and salts one half hour, then add Congo red. Filter through cotton and tube. Autoclave tubes fifteen minutes at 115° C.

The bacterium causing the wilt is a polar flagellate rod 2-3 to 3μ by 1-3 to 1-2μ occurring singly or in pairs, and has been named *Bacterium flaccumfaciens* nov. sp.

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THE PERIPHERAL CIRCULATION IN MUSCLE INJURY SHOCK

The following experiments were undertaken in an attempt to determine the influence of the peripheral tone in the production of the low blood pressure initiated by muscle injury. Evidence has been presented by a number of observers indicating that the vasomotor center is still active in shock produced by the exposure of the viscera or aortic occlusion, and that some peripheral tone is maintained.[1] A recent paper by Erlanger, Gesell and Gasser[2] presents results of a series of experiments in which, in these types of shock, the condition of peripheral constriction was directly determined by the rate of perfusion through the arterioles and capillaries. They show that during the development of shock the peripheral resistance is increased, and that only after the arterial pressure has fallen is there a loss of vasomotor tone, and consequently that a loss of tone is not the primary cause of shock. Our results are in accord with these findings and are presented as evidence indicating that the nervous factor is of minor importance in the causation of the low blood pressure following muscle injury, as in other forms of shock.

The method of determining the relative condition of vasomotor tone was that described by Bartlett,[3] and used by Erlanger, Gesell and Gasser. The rate of inflow of a fluid at constant pressure through the femoral artery of one hind limb was determined at intervals during the development of shock. The inflow cannula was placed in a side branch of the femoral artery or low down on the main branch directed towards the heart. With this arrangement, through the use of clips on the arteries, it was possible to shift quickly from the natural blood supply of the area supplied by the intact branches of the femoral artery to the perfusion fluid and *vice versa*. The perfusion fluid was

[1] Porter: *Am. Jour. Phys.*, 1907, XX: 399. Porter and Storey: *Ibid.*, 1907, XVIII: 181. Porter and Quinby: *Ibid.*, 1908, XX: 500. Seelig and Lyon: *Jour. A. M. A.*, 1909, LII: 45; also *Jour. Surg. Gynecol. and Obstet.*, 1910, 146. Seelig and Joseph: *Jour. Lab. and Clin. Medicine*, 1916, I: 283. Mann: *Johns Hopkins Hosp. Bull.*, 1914, XXV: 205. Morison and Hooker: *Am. Jour. of Phys.*, 1915, XXXVII: 86.

[2] Erlanger, Gesell and Gasser: *Am. Jour. of Phys.*, 1919, XLIX: 90.

[3] Bartlett: *Jour. Exp. Med.*, 1912, XV: 414.

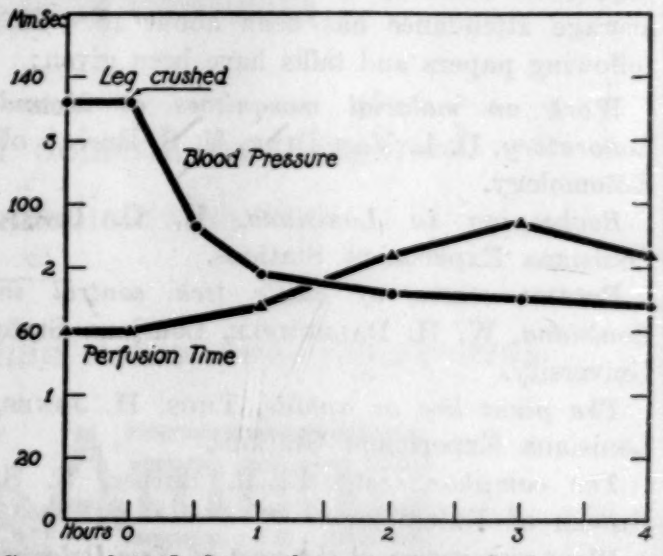
SUMMARY OF RESULTS SHOWING PERFUSION TIME FOR 1 C.C. OF PHYSIOLOGIC SODIUM CHLORID SOLUTION IN RELATION TO BLOOD PRESSURE IN MUSCLE INJURY SHOCK

Experiment	Control perfusion time, seconds	Maximal perfusion time, seconds	Period after injury, hours	Percentage increase	Perfusion time at end, seconds	Perfusion time after death, seconds	Original blood pressure, Mm.	Blood pressure at maximal constriction, mm.
8	5.2	12.9	0.75	144	4.7	....	140	90
9	2.3	3.3	1.0	43	2.9	1.8	130	16
10	1.4	2.4	4.0	71	....	1.2	140	74
12	1.2	2.7	4.5	125	1.1	0.8	130	68
14	0.8	1.5	1.5	87	1.0	0.5	130	60
15	1.3	3.7	1.25	185	....	1.3	120	72
16	1.6	4.0	3.5	150	....	....	135	78
18	2.7	4.0	4.5	48	....	....	125	65
19	1.5	2.5	6.0	66	....	1.1	135	42
20	1.4	2.5	....	78	....	....	130	92
21	1.0	1.7	3.0	70	0.9	0.6	130	60
Average	1.85	3.74	3.0	102	2.1	1.0	131	65

kept at a constant pressure by connecting the injection burette with a large bottle containing air at a constant pressure as indicated by a mercury manometer. A side tube on the burette connected with a bottle of normal saline solution served to refill the burette to the original level after each perfusion. In making a determination of the perfusion rate, about 3 c.c. of fluid was allowed to run into the artery while the time was being recorded with a stop watch. Such a determination required but a few seconds, and immediately after the clip on the main trunk was removed, thus allowing the part to receive its natural blood supply.

Cats, anesthetized with ethyl carbamate (urethane), were used. Shock was produced by the method described by Cannon.[4] The muscles of the right leg only were crushed, those of the left being left intact for the inflow measurements. In a few instances in which perfusion was interfered with by small clots forming in the vessels, the experiments were discarded. The condition of the vessels was tested by inflow determinations after death, when, if there is no obstruction, the rate of inflow is greatly increased. A blood pressure record was obtained from the right carotid by means of a mercury manometer.

A summary of the results is given in the table. The figures represent the time in seconds for the entrance of 1 c.c. of fluid, and in each case they are the average for at least three determinations. Frequently at the beginning of an experiment the readings indicated considerable variation in vascular tone, necessitating a number of observations to determine the control rate. Invariably there was a gradual increase in the time (*i. e.*, decrease in the rate) of inflow after muscle injury, usually starting within the first hour and reaching a maximum in from two to four hours. After this a dilation occurred which continued until the death of the animal and was accompanied by a further fall in blood pressure. As already stated, the perfusion rate was still further increased after death. A curve showing the general relation between the blood pressure and the tone of the blood vessels during the devel-



Curve plotted from the averages of six experiments showing the relationship between the perfusion rate and the blood pressure in muscle injury shock. As the blood pressure falls, there is a slowing of the perfusion rate, indicating an increased tone of the arterioles.

[4] Cannon: *Arch. of Surg.*, 1922, IV: 7.